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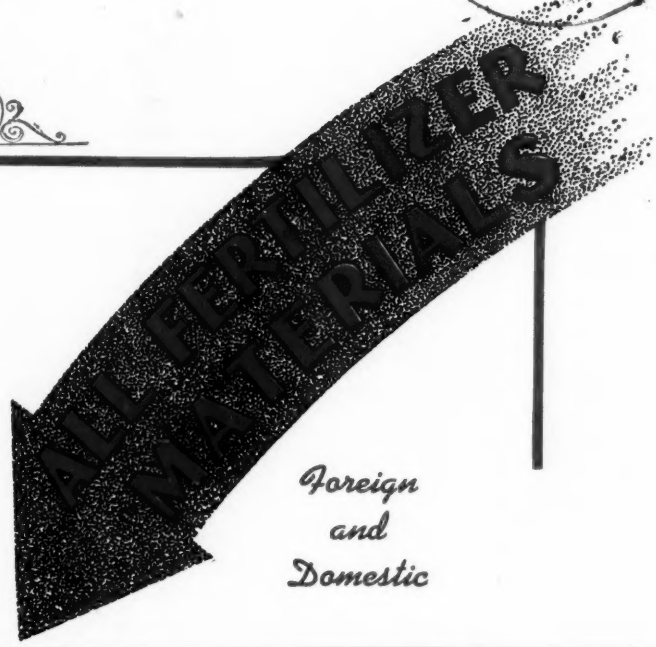

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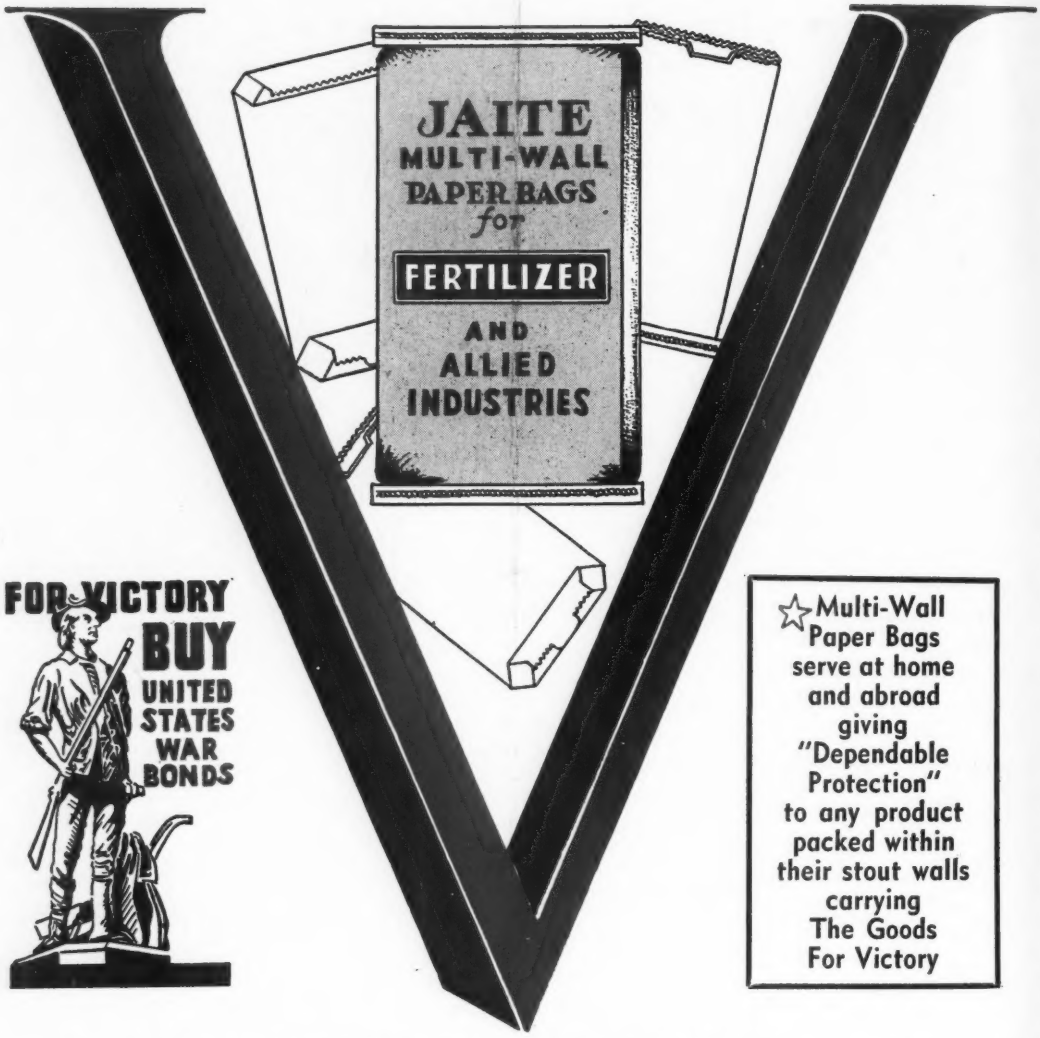

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Vol. 102 JUNE 16, 1945 No. 12

Correlative Factors in Rapid Chemical Tests

By JACKSON B. HESTER*

MAN is not judged by the fact that he managed to survive, but by how well he lived—not by the mere fact he existed, but by what he contributed while he lived. In most parts of the world man has to work in order to live, and even in those parts of the world where food is plentiful for those that are there, he has to work if he lives well because most things in their natural state can only supply the materials for the requirements of man. In many parts of the world nature is a stern task master and has no regard for the whims of man or for his existence as for that matter. Because man has some knowledge of the human body, e.g., the relation of each part to the other or to the whole, he is often able to avoid behavior which injures the well-being of the body as a whole. Because the average man does not have sufficient knowledge of the soil as a whole, e.g., the relation of each part to the whole, he is often unable to avoid practices that injure his ultimate aim.

Involved in soil management are three fundamental sciences, physics, chemistry and biology. However, one cannot divorce the question of chemistry or biology from the study of the physical problems of the soil or the physical problems in studying the chemical or biological problems. The nature of the soil determines the importance of each problem. For example, the nature of the soil or lay of the land and the cropping practices determine the importance of wind or water erosion. The physical attributes, sand, silt, and clay, influence the chemical and biological problems. The climatic conditions and physical composition influence the question of leaching and accumulation of nutritional elements naturally present in the soil. Be this as it may, two of the fundamental aspects of the soil are its chemical make-up and chemical relationships, both of which contribute much to the success of the grower on the soil. A large proportion of the efforts of man has been to ascertain ways of furthering his fundamental knowledge along these lines and the application of the knowledge to the individual problem in crop production. Too often the chemical problems of the soil are studied without regard to the plant. Since the production of the plants is the ultimate aim of all research conducted upon the soil, paramount in soil research is the influence of the existent factors in the production of the plant. The chemical reactions in the soil might be likened to the stomach of man in that the store house and distributing system of the plant nutrients come from this source. When this does not function properly we are in serious trouble indeed.

Since the epic studies of Justus von Liebig (1840) and J. T. Way (1850) scientists have devoted more and more study to the chemistry of the soil. The literature on the development of soil chemistry is the most interesting and fascinating reading. However, this short article is to deal with some of the pertinent problems involved in a simple chemical study of the soil as revealed by rapid chemical tests. Involved in the soil chemistry are the organic and mineral colloidal materials.

Colloidal Materias

Soils vary so tremendously that even the most specific generalization is subject to criticism. However, the main productive soils settle down to more confined limits. While the organic matter in peats may be as

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high as 95 per cent and that of sands as low as a few tenths of one per cent, the general agricultural soils vary in organic matter content between 1 and 8 per cent and the clay content between 5 and 50 per cent and even these broad limits may be reduced for a given section or area. Within the confines of the organic matter and clay micelle is involved the chemistry of the soil that supports the great function of plant and animal life of the world.

Some three major elements (nitrogen, phosphorus and potassium), some three minor nutrients (calcium, magnesium and sulphur) and some unknown number of trace elements (boron, iron, manganese, copper, zinc, etc.) are supplied the plant from this elusive complex (the colloidal phase). Chemical analyses of vigorous plants of various economic values have established about the optimum amount of these compounds necessary for abundant growth, but just how the soil complex supplies the plant or just how the plant goes about obtaining the elements from the complex is not entirely a clear picture. It is known, however, that in an average soil all the time that plants are growing there must be going on an active decomposition of the organic matter. This decomposition liberates anions of stronger negative electric charges than the clay, thus making it possible for the replaceable bases, calcium, magnesium and potassium, to be released from the colloid. Thus, organic matter + biological decomposition ←→ nitric + carbonic + sulphuric acid, etc.

Nitric acid + calcium clay ←→ acid clay + calcium nitrate (available to plant)

Carbonic acid + potassium clay ←→ acid clay + potassium bicarbonate (available to plant)

Sulphuric acid + magnesium clay ←→ acid clay + magnesium sulphate (available to plant)

Furthermore, these are only a small portion of the actual reactions going on, for the liberation of iron and manganese, etc. are involved along with many other complicated reactions. So, from this it is seen that to get a clear picture as to what is expected to happen in the soil for a given period, one must have a number of facts at hand. Among the outstanding facts that one needs to know is the (1) soil type (approximate sand, silt and clay content), (2) drainage conditions (color of surface and subsoil), (3) *p*H value of soil, (4) approximate replaceable calcium and magnesium content, (5) organic matter content, (6) presence of toxic elements (aluminum, etc.), (7) approximate nitrogen content, (8) available phosphate content, (9) approximate replaceable potash content, (10) available manganese content, and (11) fundamental knowledge of soil chemistry, etc.

How shall we go about getting this information? There must be available rapid and rather accurate chemical tests for various elements and compounds. But, first and above all else, there must be an accurate soil sample drawn. An acre of ground in the plowed surface carries about 2,000,000 to 3,000,000 pounds of soil. A soil sample to truly represent the surface soil must be taken when the soil is in a state of comparative equilibrium; that is, not when the soil is extremely wet (after leaching rains) or extremely dry (after prolonged dry weather). A good time to take the sample is when the soil is in a state of good tilth. However, if one knows the condition of the soil when the sample was taken, some compensation can be allowed for the actual analyses. This sample must represent the majority of the soil under consideration. In other words, if there are abnormal conditions in the field, the soil from these areas must be sampled and analyzed separately.

The sample of soil must be screened through either a one- or two-millimeter sieve and thoroughly mixed. If properly mixed, even as little as 10 to 20 grams of soil may be sufficient to represent the area in question. However, if the sampling, screening or mixing is improperly done, all subsequent work, no matter how accurately done, will be proportionately in error. When this thought is carried through, it is little wonder that there are variances in many of the analyses and recommendations made upon soils.

Soil Analyses

Paramount in the chemical analyses is the knowledge of the reactions of the extracting reagent used. Total chemical analyses were discarded long ago as a measure of the available plant nutrients in the soil. This can easily be demonstrated with rock phosphate. Even though rock phosphate may analyze 25 per cent P_2O_5, little of this is available until acted upon by acids to bring it into solution. One of the promising criterions for available calcium, magnesium and potassium is the replaceable method whereby a given amount of soil is leached with a salt solution and finally the salt is destroyed by heat and the analyses for the constituent made. This is long and tedious and only gives a factor from which the plant-available bases are estimated. The author firmly believes that for the plant

to get nutrients from the colloid, a strong electrolyte must be introduced into the picture. For example, the colloid is amphoteric and therefore holds positive ions like calcium, magnesium, potassium and ammonia. However, to say it is amphoteric and holds positively charged ions is not the whole story for its attraction for nitrates, chlorides and sulphates is only slight, but phosphorus and arsenic are strongly held. This is perhaps due to the active complexes of iron and aluminum that give these elements in solution to precipitate the phosphorus and arsenic. However, this occurs on the acid soils to a much greater extent than on neutral or alkaline soils.

Soils vary so much in their exchange capacity that it is difficult to obtain an extracting reagent that will work the same on all soils. So what is attempted to be done is to use such a concentration of salt that the reaction with the soil will not change the concentration of the salt greatly. Sodium acetate and acetic acid have been selected by a number of workers. For this solution to be effective it must be allowed to come to an equilibrium with the soil. In other words, you mix the soil with a salt solution and shake the mixture until an equilibrium has been established. This mixture is then filtered for analyses. The extracting reagent should not break down the soil colloid for two reasons: (1) the plant does not do this to obtain the necessary nutrients (except to a very limited extent); and (2) the breakdown causes ions to come into solution that interfere with the rapid analyses.

Calcium

Using soils with a calcium oxide content of less than 500 pounds per acre and more than 10,000 pounds per acre of replaceable, the author found that the sodium acetate concentration proposed and method of extraction used gave the following curve shown in Fig. 1. These data are valuable because, if one has a satisfactory short test, he can calculate approximately the amount of replaceable calcium in the soil in pounds per acre. To get the pounds of calcium oxide per acre multiply the milliequivalents per 1000 grams of soil by 56. The analyses support the fact that the 0.3 normal solution of sodium acetate—acetic acid mixture (10 g. NaOH and 20 mls. acetic acid per 2 liters) brought into solution approximately two-fifths of the replaceable calcium. The soils used in this study were seven common to the Coastal Plain, two common to the Plateau, two Midwestern soils and four Canadian soils. Using the results of the analyses of these soils and other data as a basis, Fig. 2 was constructed. However, this

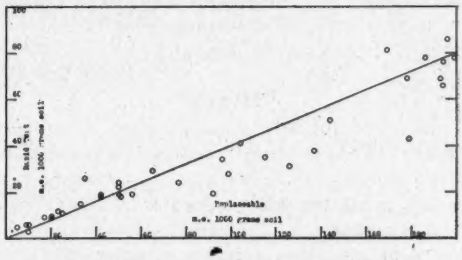

Fig. 1. Correlation curve of rapid chemical tests with replaceable calcium (15 different soil types)

chart only holds good for soils of medium texture. So, if one has a large variation in soils, one must use the interpretations in Fig. 3. These diagrams have been constructed

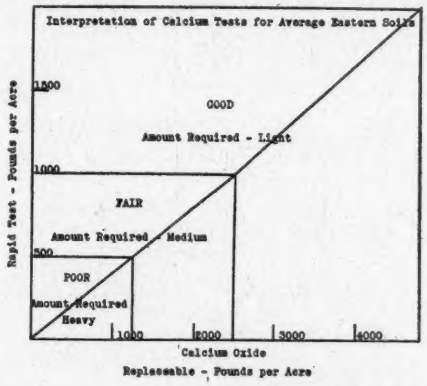

Fig. 2. Interpretation of calcium tests for average eastern soils.

from a study of average soils. The introduction of large amounts of magnesium limestone or sodium nitrate may alter them somewhat.

There is a relation of the calcium content of a soil to potash fertilization. It has been closely established that plants will take up calcium in preference to magnesium and potassium when calcium is in great excess and vice versa. Consequently, when the calcium contents of the soil are high, the amount of potash needed to grow a crop is increased. Furthermore, if the calcium and magnesium contents of the soil are increased, the potassium content should likewise be increased. The fact that the short test can be reproduced with

reasonable accuracy and there is a correlation established between the short test for calcium and the replaceable calcium content of the soil, it is concluded that the short chemical test gives reliable and satisfactory information about calcium. However, the interpretation of the tests will be determined by the requirements of the crop to be grown.

Magnesium

Magnesium behaves somewhat differently from calcium in many respects. It neutralizes the soil colloidal acid similar to calcium, but it forms with the soil colloid somewhat more stable complexes. The author has been interested in magnesium for a number of years. In fact some of the original work done with magnesium deficiency in potatoes in Eastern Virginia was done by him. So the test was

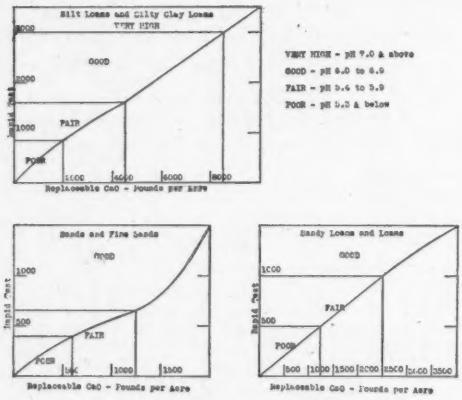
Silt Loams and Silty Clay Loams
VERY HIGH
GOOD
FAIR
POOR
Rapid Test
Replaceable CaO - Pounds per Acre
VERY HIGH - pH 7.0 & above
GOOD - pH 6.0 to 6.9
FAIR - pH 5.4 to 5.9
POOR - pH 5.3 & below
Sands and Fine Sands
Sandy Loams and Loams

Fig. 3. Interpretation of calcium tests

designed with the idea of detecting magnesium deficiency in various crops in Virginia; however, good correlation has been obtained with tomatoes and other crops in New Jersey and Pennsylvania. It is believed that injury to crop yield and quality is done before the deficiency symptoms show up in the leaf structure.

Actually with magnesium, the short test gives almost the same results as those found by leaching the soil with neutral salts. This correlation with fifteen widely different soils is shown in Fig. 4. About four-fifths of the amount replaced by leaching with neutral salts is extracted by the short procedure. Here again, to obtain the replaceable magnesium in the soil where the results of the short test are known consult the curve in Fig. 4. To obtain the pounds of magnesium oxide per acre, multiply the milliequivalents per 1000 grams of soil by 40.

Potassium

A great deal of time and energy have been devoted to the study of available potash. From time to time the author has published articles on the correlation of the soil test with plant response. Under greenhouse conditions where the external factors are controlled, satisfactory correlations have been obtained. However, under field conditions these correlations are not always obtainable. Again, using a large number of soils with varying soil conditions and varying amounts of replaceable potas-

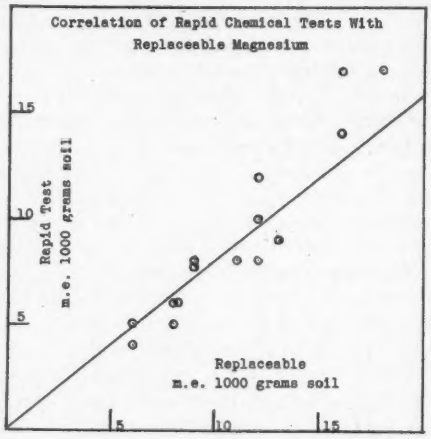

Fig. 4. Correlation of rapid chemical tests with replaceable magnesium

sium, the fact that the rapid test extracted approximately two-fifths of the replaceable potash was established. The interpretation for this study is shown in Fig. 5. The calibration chart for potash is shown in Fig. 6. These data have likewise been correlated with field tests. Too often in experimental results the total picture has not been taken into consideration, and because a certain unit did not give response, it is concluded that potash is not needed; whereas, if other limiting factors are removed, a given unit of potash will increase the yield in proportion to its efficiency.

Data represented in Fig. 5 are important because if one has an accurate rapid test he can interpret the approximate amount of re-

(Continued on page 26)

Formation of American Plant Food Council

In a movement to bring about a more efficient manufacture and distribution of fertilizers by keeping the ownership and operation of producing plants in the hands of private industry, the American Plant Food Council has been organized by a group of fertilizer executives, according to an announcement on June 10th. The charter members are H. M. Albright, U. S. Potash Co., New York; C. F. Burroughs, F. S. Royster Guano Co., Norfolk; J. Albert Woods, Chilean Nitrate Sales Corp., New York; A. Lynn Ivey, Virginia-Carolina Chemical Corp., Richmond; J. E. Sanford, Armour Fertilizer Works, Atlanta; Oscar F. Smith, Smith-Douglass Co., Norfolk; George E. Petitt, Potash Co. of America, New York.

According to information received from Oscar F. Smith, chairman of the organization committee, a charter has been granted to the Council and an organization meeting was held in Washington on May 20th, at which time temporary officers were chosen.

The Council has two principal objectives, as follows:

1. To promote better public relations between the industry, the Government, and the public. This field includes information to the public on the importance of maintaining a highly competitive industry as a means of providing adequate, proper, and economical plant foods for a progressive agriculture and a high quality diet for all.

2. To provide an educational service for informing members of the industry and the farmers of the nation as to the plant food needs of agriculture, as developed through experimental and other methods, by the country's land-grant colleges, the United States Department of Agriculture, and by farmers themselves, to the end that the members of the industry may develop and operate their facilities in keeping therewith. To cooperate with Federal and State authorities, particularly State Colleges of Agriculture, State Extension Services, and Experiment Stations, in conducting experiments, studies and surveys, for the better utilization of fertilizers.

Membership in the Council will be open to all those directly engaged in producing, mining, refining, importing, manufacturing or selling phosphate rock, superphosphate, potash salts, nitrogen compounds and other carriers of recognized plant foods. Also to mixers of these materials, including cooperative organizations so engaged.

Affairs of the council will be administered by a paid president, yet to be named, who will be responsible to a board of directors. The board, elected by the membership, will consist of eighteen. There will be an executive committee of five, selected by the board from its membership.

AAA Farmyard Delivery of Lime

J. M. Napier, AAA extension agent in South Carolina, announces having established vendors or local dealers in each county who are offering lime on a farmyard delivery basis. The offer covers both ordinary ground limestone and dolomitic limestone.

AAA bears approximately 80 per cent of the cost of the limestone delivered, the farmers paying the remainder to the dealers. Farmers, however, can buy liming material through ordinary commercial channels, according to Mr. Napier, on the same basis as when buying through AAA, provided the requirements of AAA are met.

Cyanamid Destroys Molds

A white mold causing soft watery rot of snap beans of concern to sections of Florida, has been brought under control by applications of cyanamid to the soil. The same fungus had previously been controlled on celery by the same means. The discovery of the control measure for celery was made by Dr. A. N. Brooks, and the application to snap beans was worked out by Dr. Brooks, H. I. Borders of the Florida Agricultural Experiment Station, and W. D. Moore of the United States Department of Agriculture.

They now recommend broadcasting granular cyanamid uniformly over the field at the rate of 1000 pounds per acre. They suggest that the material be applied to the soil in early May. This gives the soil time to return to normal pH reaction by fall and assures that the material will not be toxic to bean plants that follow, according to a statement contained in *Press Bulletin 613* of the Florida Experiment Station.

Cyanamid, of course, is a nitrogenous fertilizer, and fertilizer for beans on the cyanamid treated soil would be modified accordingly.

National Fertilizer Practice Survey

The National Fertilizer Association has issued a partial preliminary report on the results of the Third National Fertilizer Practice Survey now being made throughout the country. Answers have been received from more than 14,000 farmers and the tabulated replies to nine of the questions asked are as follows:

Question 5. Have you improved your methods of applying fertilizer in recent years? The answers show that, for the nation at large, slightly more than half have improved their methods of application, the figures being 53 per cent in the affirmative and 47 per cent in the negative. Affirmative answers ranged from 63 per cent in the Middle Atlantic States to 42 per cent in the East North Central States.

Question 6. Did you use commercial fertilizer before 1940? Here the replies showed how widespread the use of fertilizers has become, 91 per cent answering "yes." As was expected the eastern and southern states ran above the average, with percentages as high as 98 per cent in some sections. Middle Western and Far Western States showed that about three-fourths of the farmers had used commercial fertilizers before the war.

Question 7. Were you able to obtain as much fertilizer as you wanted to buy this year? The splendid war job done by the fertilizer industry is reflected in the fact that 93 per cert of the replies were in the affirmative. Only in Louisiana, Arkansas, Texas, the West North Central States, the Mountain States, and the Pacific States did more than 10 per cent of the farmers fail to get fertilizer in amounts they considered adequate.

Question 8. Were you able to buy the grades or materials you wanted? It is interesting to note that 21 per cent of the replies were in the negative. Apparently many farmers have developed very individualistic preferences for fertilizer grades that could not be met by the limited number of grades decreed by the authorities. Here again the Eastern and Southern States have made the most progress in selling standard grades as affirmative replies were above the national average.

Question 8a. If you were not able to buy the grades or materials you wanted, were the substitute grades or materials satisfactory? This question was answered only by those replying in the negative to Question 8. Sixty-three per cent were satisfied with their wartime fertilizer while thirty-seven per cent were not. The dissatisfaction was greatest in the western part of the country.

Question 9. Is the service you receive from your fertilizer dealer or company satisfactory? The splendid service being rendered by the industry was demonstrated by the fact that only 2 per cent answered "no" to this question. This would seem to give a good answer to those who favor a government-operated fertilizer industry.

Question 10. Did you have more acres in crops this year than before the War? Only 37 per cent of the farmers indicated an increase in acreage planted. The greatest percentage of increases were in the New England and Middle Atlantic States and in the Middle West.

Question 11. Are you fertilizing more across now than before the War? To this question the replies were about evenly divided, 52 per cent answering "yes" and 48 per cent answering "no." As was to be expected, the states showing the largest percentage of affirmative answers were in the Middle West and Far Western States, sections where the prewar use of fertilizers was not so extensive as in the East and South.

Question 12. Are you applying more fertilizer per acre than before the War? The answers to this question showed 55 per cent "yes" and 45 per cent "no." The smallest increases were in the New England and Middle Atlantic States. In many cases, no doubt, the inability to obtain larger supplies of fertilizer made a negative reply to this question necessary.

Question 13. Do you plan to use more fertilizer next year? For the entire country, the answers were 51 per cent "yes" and 49 per cent "no." The sectional tabulation of the affirmative vote was as follows: New England, 39 per cent; Middle Atlantic, 37 per cent; Southeast, 38 per cent; South Central, 61 per cent; Southwest Central, 63 per cent; Middle West 61 per cent; Mountain and Pacific States, 77 per cent.

Question 14. If farm prices decline only moderately after the War, will you spend less money on fertilizer? The replies to this question showed that the farmers appreciate fully the need for adequate plant food under all conditions. The "yes" replies were only 22 per cent of the total, and of the principal fertilizer-using sections, only in the South Central States did the percentage rise as high as 30 per cent. Out of 29 replies from New Hampshire farmers, not one indicated an intention to reduce his fertilizer expenditures.

IT MAY BE

By SAMUEL L. VEITCH

New Function of Draft Boards

It may be, from now on, the chief job of the Draft Boards will be reinstating discharged veterans in jobs, rather than in drafting men for war. The Selective Service Law provides that the Draft Boards must help the veteran get his old job or a job. (It will be interesting to see how this works.) It is estimated that inductions will drop 25 per cent—to 90,000 per month—while discharges will increase 60,000 to 150,000 a month.

The Army has been authorized to resume the acceptance of enlistments in the regular army. Enlistments can be made for three years or for the duration and six months thereafter.

Discharge Point System

A great deal of criticism has been directed at the discharge point system. In fact very few are entirely satisfied with it. There are so many people who have sound and compelling reasons for securing a discharge that it is obviously impossible to take care of all of them, and yet maintain the Army at its required size. The chief arguments against the present method are that it did not take into account the factor of age nor the factor of dependency in full. While a soldier is given a 12-point credit for children under 18 years, yet no credit is allowed for a wife. This has been discussed frequently with members of the Military Affairs Committee, who in turn have been in direct touch with high officials in the War Department. They give some assurance the War Department is making a careful statistical study of just how many men will leave the Army under present setup. As soon as enough time has elapsed to enable them to draw their conclusions with a reasonable degree of accuracy, it is their expectation to make changes in accordance with the results of the study. A good many of the men eligible for release under the point system will elect to stay in. This will permit further liberalization for those who desire to return to civilian life. Already the War Department has made two rulings liberalizing the system in respect to age. The announcement was that men 42 or over could make application for release; the second came along a short time afterward reducing this to 40 years. It is now their hope to bring this age limit down to 37 or 36 years. (Something will have to be done for the WAC's. Can you imagine a woman admitting to be 36?) The reduction of the lower age limit may not come all at one time. There will probably be an announcement reducing the age to 38, and then later on to 37 or 36 and possibly 35. Also the question of dependency, particularly in respect to wives, is receiving careful study. The Army wants to be sure not to err by starting out with a system so liberal that it would later be forced to restrict it.

Military necessity must remain controlling. The Army is very specific about this. Hence some men in certain areas, and in some branches of the Service, where specialized knowledge and skills are required, may not get out even though they have the points. But the Army is rather assuring that military necessity will mean military necessity, and not just military conveniences.

Expenses for Congressmen

We have spoken with several Congressmen asking how they voted on the proposed $2,500 a year expense increase. Would you believe it if we told you everyone said he didn't vote for it? That's right; that is what they said. In a case like that, we wonder how come the vote was 206 for the increase of $2,500 as against a vote of 152 "No's." This seems to have the appearance of the "old hidden ball play." It may be bad policy to permit any group to increase their own remuneration during their tenure of office. This is generally recognized because many State Constitutions contain specific provision prohibiting such action. If $2,500 can be voted, there is no logical reason why $50,000 could not be voted. The chief argument of the proponents was that expenses have risen during the past few years. This seems to be an argument against rather than for. Every other group in the country has been faced with the same problem. Every other group can bring in data showing that their expenses have risen, and probably in at least as great a proportion. This is true of steel workers, doctors, lawyers, white collar workers, and Mr. John Q. Public in general. Everyone knows that our struggle today is to prevent inflation; Congress should set an example. A committee has been appointed to study the whole subject of the reorganization of Congress and improving and streamlining it. It is rumored, the boys better get the increase before this committee makes recommendations or it just won't be.

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Fertilizers and Europe

It does not follow that the cessation of war means an immediate resumption of exports of German and French potash; or Norwegian and German synthetic nitrogen to this country. Europe needs all of these fertilizer materials, and more, for its depleted soils.

As a matter of fact, immediate production of synthetic nitrogen is not likely to be more than a trifle of the prewar output because nitrogen plants have been the special marks of aerial bombs. How far the devastation of the synthetic nitrogen plants has extended and how long it will take to repair and restore their productivity will require an extended survey.

Potash mines naturally escaped bomb destruction and such damage as was inflicted is not likely to cause much delay to resuming operations. When operations of the mines are resumed and exportations start, it is expected that sales will not be conducted jointly by French and German interests as formerly, though it is too early to say what plan for promoting the sale and distribution of European potash may be finally worked out. How far government-supported cartels in Europe will be permitted to function under the new order will enter into the adjustments that will be made.

Instead of the United States importing fertilizer materials as before the war, more than likely this country will be called upon to export fertilizer materials to Europe in greater amounts than ever before for the next few years; yet if this country is to do its best to feed a hungry world there will not be much plant food to spare above the needs of our own farmers.

Supplying the fertilizer needs of Europe, from whatever source, brings up the question of the ability of Europeans to pay. After World War I, Americans loaned Europeans money with which to buy our products, a plan that did not always work out. Exchange of goods so as to maintain trade balances is considered essential to sustained trade, but until European countries can get capital to restore their plants to an operating basis, they will have little to offer in exchange for raw materials and goods.

At any rate the problems of trade resumption are not going to be easily solved. Trade in plant foods between this country and Europe is not likely to require immediate attention in view of the pressing intra-European demands for all plant food produced in the war-torn countries for the next few years.

Potash Co. of America Continues Price Schedule

On June 12th, the Potash Company of America announced that the price schedule dated May 1, 1944, has been continued for the fertilizer year ending May 31, 1946. The same terms and conditions will also apply, with all dates in the original schedule advanced one year.

Side-Dressing Corn

With applications of 300 to 400 pounds of complete fertilizer on land receiving no manure, the Maryland Experiment Station says that yields of corn, wheat, barley and rye have been increased by larger amounts of nitrogen up to 6 per cent in the fertilizer. In one series of tests, each pound of nitrogen in a 4–12–6 fertilizer produced 0.54 bushel corn more than was produced by an 0–12–6 fertilizer, as a three-year average.

Gorman and Ballard Appointed Cyanamid Divisional Sales Managers

American Cyanamid Company, Fertilizer Division, has announced the appointment of James Gorman as Sales Manager, Divisional.

Joining the Cyanamid Company in 1927 as a field representative, Mr. Gorman became District Sales Supervisor of the Middle Atlantic States in 1932, in which capacity he established an outstanding record for sales. In 1939 he was appointed to the position of Assistant Sales Manager, Agricultural Cyanamid, and transferred to the New York office.

In his present capacity, Mr. Gorman will handle all sales of cyanamid for agricultural purposes in the eastern half of the United States.

Announcement has also been made of the appointment of George F. Ballard as Sales Manager, Divisional.

Mr. Ballard joined the American Cyanamid Company in 1932, when he became field representative of the Fertilizer Division, in Michigan. Shortly thereafter he was appointed District Sales Supervisor of the North and South Carolina territory, and in 1935 he joined the New York office staff as Assistant Sales Manager, Phosphate Rock.

After twenty years with W. R. Grace Company, Mr. Ballard established his own nitrate of soda business, The American South Pacific Company, in 1924. Prior to his present association, he was associated with the Barrett Company.

Mr. Ballard will handle all sales of Florida pebble phosphate rock for acidulation and ground phosphate rock for both mixing and direct application, in his new position.

Fertilizer Plant Facilities Adequate for Postwar Needs

"There is neither justification nor necessity for Government production of fertilizers," said D. S. Murph, the Executive Secretary and Treasurer of the National Fertilizer Association, in commenting on some recent proposed national fertilizer programs, including S. 882 and H. R. 2922, companion bills introduced into the Senate by Senators Hill and Bankhead of Alabama and into the House of Representatives by Representative Flannagan, of Virginia. "The industry under the private enterprise system," said Mr. Murph, "except as temporarily prevented in certain localities by war conditions, has always supplied the entire demand of farmers for fertilizers.

"Under the stress of war needs fertilizer production was stepped up from the prewar 1935–1939 average of approximately 7,350,000 tons to more than 12,000,000 tons in 1944. And there is still unused plant capacity. Production in 1944 was not limited by plant capacity but by scarcity of some materials, transportation difficulties, and labor shortage. Fertilizer production capacity has always far exceeded consumption.

"It is hard to understand," Mr. Murph continued, "why anyone should assume that the fertilizer industry will not continue to meet the farmers' demands. Past history and plans for the future point to just the opposite conclusion. Expansion of plant facilities when and where needed, as now contemplated by fertilizer manufacturers, indicates beyond question that the industry will meet all demands which may arise.

"There is another reason why Government participation in fertilizer production is not justified," Mr. Murph said. "Fertilizer is today about the cheapest thing the farmer buys. Figures of the U. S. Department of Agriculture show that, as compared with 1910–1924, the period commonly used for comparison, fertilizer prices have advanced only 21 per cent, while the prices paid by farmers for all the things they buy have advanced approximately 80 per cent."

May Tax Tag Sales

The rise in fertilizer tax tags over last year's level continued in May, with aggregate sales for the month in the 17 reporting States showing a 15 per cent increase over May, 1944. A 17 per cent increase was recorded over May, 1943. Declines from last year occurred in seven States but these were much more than offset by increases in the other ten. The net result was a 70,000-ton rise.

Sales in the first five months of this year exceeded the corresponding period of 1944 by 383,000 tons, or 8 per cent. Gains over last year were reported by all of the States except Louisiana and Kansas and the declines in these two were comparatively small.

Tag sales in the current fiscal year are at a new all-time high point. July-May sales are 435,000 tons larger than in the first eleven months of last fiscal year. Increases over 1943–1944 are 4 per cent in the South and 19 per cent in the Midwest. These figures indicate that a new peak on a calendar year basis may be registered in 1945, which would make the seventh consecutive year in which tonnage is larger than in the preceding year.

FERTILIZER TAX TAG SALES

State	May				January-May		
	1945 Tons	1944 Tons	1943 Tons	% of 1944	1945 Tons	1944 Tons	1943 Tons
Virginia	55,298	35,072	36,459	117	366,386	314,405	310,183
North Carolina	81,478	92,087	83,651	109	1,123,387	1,031,159	1,062,646
South Carolina	37,800	37,836	37,143	104	639,668	613,867	683,038
Georgia	34,745	46,786	40,067	104	852,430	818,909	844,781
Florida	71,513	78,878	63,498	101	401,925	397,704	338,673
Alabama	29,500	9,150	41,700	110	593,650	540,400	610,500
Mississippi	40,200	15,522	33,431	104	299,617	287,826	325,167
Tennessee	37,575	33,025	26,183	108	211,225	196,468	180,222
Arkansas	15,750	7,600	4,570	101	95,650	94,583	140,055
Louisiana	11,550	7,550	5,075	94	123,736	131,635	142,138
Texas	15,200	9,000	12,380	104	138,235	132,576	125,610
Oklahoma	300	600	339	134	14,962	11,151	14,910
Total South	430,909	373,106	384,496	106	4,860,871	4,570,683	4,777,923
Indiana	33,466	24,737	33,675	102	177,914	174,474	230,800
Illinois	20,964	19,600	11,680	143	134,389	93,730	65,414
Kentucky	33,075	28,623	14,200	120	204,533	170,197	106,208
Missouri	2,870	4,764	1,072	122	85,887	70,629	43,413
Kansas	0	525	0	92	13,865	15,001	3,290
Total Midwest	90,375	78,249	60,627	118	616,588	524,031	449,125
Grand Total	521,284	451,355	445,123	108	5,477,459	5,094,714	5,227,048

BRADLEY & BAKER

FERTILIZER MATERIALS - FEEDSTUFFS

AGENTS - IMPORTERS - BROKERS

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NEW YORK

BRANCHES

Clinton St. & Danville Ave.
Baltimore, Md.

505 Royster Building
Norfolk, Va.

Barnett Bank Building
Jacksonville, Fla.

504 Merchants Exchange Bldg., St. Louis, Mo.

FERTILIZER MATERIALS MARKET

NEW YORK

Advance Shipments of Sulphate of Ammonia During Summer Months Permitted. Nitrate of Soda Still in Strong Demand. Contracts for Future Superphosphate Being Made. Potash Prices Announced by One Company.

Exclusive Correspondence to "The American Fertilizer"

NEW YORK, JUNE 14, 1945.

Sulphate of Ammonia

In order to spread the movement of sulphate of ammonia more evenly throughout the fertilizer year, fertilizer companies are now permitted to place orders for 30 per cent of the tonnage alloted on June 1, 1944, to be delivered during the months of July, August and September, 1945. It is reported that many companies are taking advantage of this opportunity.

Nitrate of Soda

This material continues to move steadily into consumer channels for top-dressing purposes. Both domestic and imported material is in steady demand. Some munition by-product material will be available for mixing purposes during the July-October period.

Organic Ammoniates

The fertilizer industry is interested in future business but because of price levels the feed industry will have first call on most materials. Some imports of tankage are reported.

Superphosphate

Contracts are being made for future deliver, and it is understood that current prices are being continued for the 1945–1946 season. Material available for immediate delivery is being taken by mixers to finish up end-of-season orders and to build up reserves.

Potash

One company has announced a continuation of the 1944–1945 schedule of prices through the coming year. There has been a delay because of the failure of WPB to make allocations and because of the uncertainty as to what the end of the European war will mean in potash production on that continent.

Phosphate Rock

The box car shortage continues to hamper rock shipments and will probably continue until the wheat crop shipments are finished. Supplies are adequate to meet all demands and it is expected that about 250,000 tons will be exported during the 1945–1946 season.

CHARLESTON

American Plant Food Council Formed. No Reserve of Sulphate of Ammonia at End of Season. Organics Scarce.

CHARLESTON, June 14, 1945.

It has just been announced that a new association is being formed, called the American Plant Food Council, and among the charter members are some of the most prominent fertilizer manufacturers.

Organics.—The general line of organics continues scarce, with insistent inquiry.

Sulphate of Ammonia.—It is reported that stocks of this material in producers' hands will be exhausted by June, as against a fairly high carry-over which was present on July 1, 1944.

Nitrogen Solutions.—These are allocated on a month-to-month basis.

Castor Pomace.—This continues exceedingly scarce, and no relief is probable.

CHICAGO

No Fertilizer Organics Offered for Present or Future Delivery. Feed Materials Still in Urgent Demand.

CHICAGO, June 11, 1945.

Lacking new market developments, the western organic market remains very quiet. Practically no material is now being offered, even for future deliveries.

Call for feed materials continues urgent.

They're still fighting—are you?

Give Your Answer to the 7th War Loan Drive!

You are tired of war. You want to see this war won—and won quickly. You want to see our enemies smashed with vengeance—so do all of us. So, let's get it over. We can do our part by buying EXTRA WAR BONDS.

Raymond Multi-Wall Paper Shipping Sacks

are speeding war production in wartime industries and on the home front. In the fertilizer industry alone, these tough, strong, dependable SHIPPING SACKS are solving a big packing and shipping assignment. CUSTOM BUILT in practically any size, type or strength, RAYMOND SHIPPING SACKS are the answer to shipping and packing problems of powdered, crushed or granulated materials.

THE RAYMOND BAG CO.
Middletown, Ohio

Light livestock receipts curtail production. Demand for wet and dry rendered tankage finds but little on the market.

Ceiling prices remain unchanged:

High grade ground fertilizer tankage, $3.85 to $4.00 ($4.68 to $4.86 per unit N) and 10 cents; standard grades crushed feeding tankage, $5.53 per unit ammonia ($6.72 per unit N); blood, $5.53 ($6.72 per unit N); dry rendered tankage, $1.25 per unit of protein, f. o. b. producing points.

Cotton Production, 1944

Final statistics on the 1944 cotton crop, issued by the Bureau of Agricultural Economics on April 27th, reveal an output of 12,228,000 bales. The average yield per acre was 293.5 pounds of lint cotton, an all-time record for the United States, or 21 pounds per acre above the previous high record of 1942.

Total value of lint and cotton seed products for 1944 is placed at $1,525,744,000. Cottonseed meal used in fertilizers on cotton farms was estimated at 41,580 tons in 1944 and 33,870 tons in 1945. Distribution of meal and cake is estimated at 1,620,000 tons.

Hommel Adds Chemical and Equipment Division

The O. Hommel Company of Pittsburgh, Pa., has announced the organization of a Chemical and Equipment Division.

The Division has been organized around men who have had years of experience in this field. James G. McCrory will head the Division and is assisted by Charles F. McGovern. Mr. McCrory and Mr. McGovern have been associated with the chemical industry for many years.

This new Division of the O. Hommel Company will act as Sales Agents for principal manufacturers of chemicals, oils and specialties used in the paint, ceramic and general industrial field. They will represent builders of grinding mills, agitators, mining equipment and tanks. Large inventories will be carried to speed service and deliveries.

New Sales Office Opened in Pittsburgh

International Paper Products Division of International Paper Company has opened a branch sales office in Pittsburgh at 1026 Farmers Bank Building. Robert W. Lillis is District Sales Manager and his territory covers the State of Pennsylvania with the exception of greater Philadelphia. Mr. Lillis was formerly connected with Dixie Cup Company at Easton, Pa.

Some Lawn Spreads Low in Nutrients

H. R. Cox, extension specialist in soils at the New Jersey College of Agriculture, has added his voice to the warnings against the "lawn spread racket."

Sold at the rate of 50c to $1 per bucketful, the material comes to about $100 a ton. Lawn spreads sold by travelling vendors are quite similar in nutrients and organic matter value to stable manure, which usually is sold for about $5 a ton, Cox points out.

"Ingredients often include decomposed tea leaves and other waste products, analysis has shown," Cox says. "On a dry basis they contain about 2 per cent nitrogen, with smaller amounts of phosphoric acid and potash. As lawn spreads contain about 75 per cent moisture, the actual percentages of the three nutrients are quite low.

"If correctly used, these materials have value as sources of organic material, but they

Manufacturers' Sales Agents for **DOMESTIC**

Sulphate of Ammonia

Ammonia Liquor :: Anhydrous Ammonia

HYDROCARBON PRODUCTS CO., INC.

500 Fifth Avenue, New York

are poorly adapted as top dressings to lawns, the purpose for which they usually are sold. For best results they should be incorporated into the soil, as in a garden, or in preparation for seeding down a lawn. They may be used also as mulches around shrubbery and other plantings.

"Frequently the vendors follow unethical practices in disposing of lawn spreads, the prospective customer often finding that a considerable amount of material has been applied to his lawn before he has agreed to buy it. If the home owner has trouble with such vendors, it would be well for him to call the police."

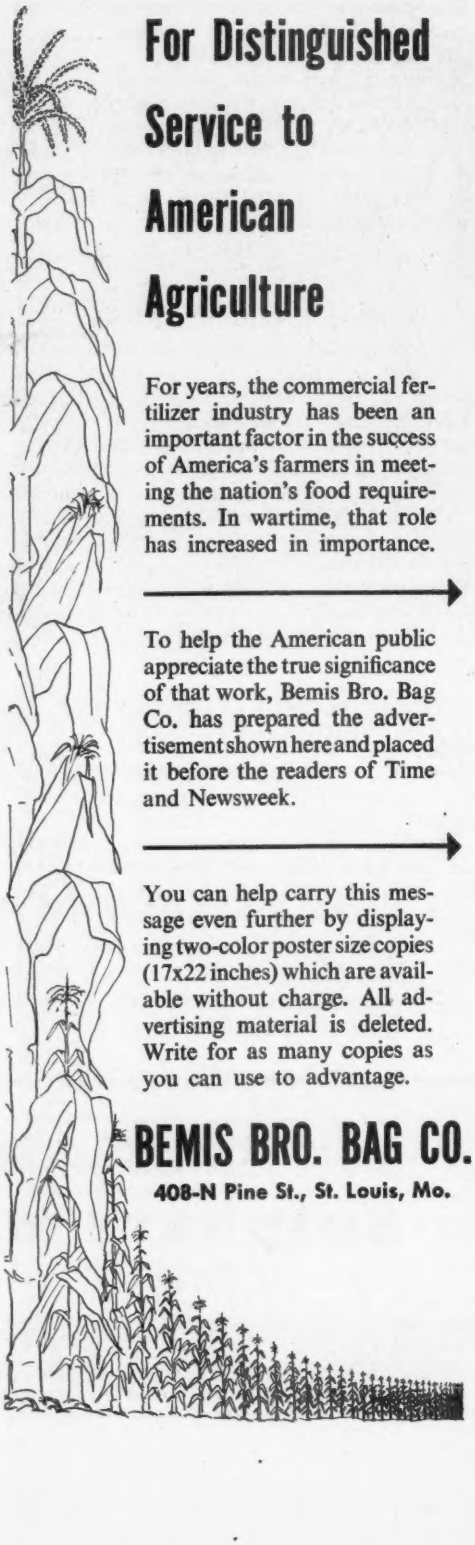
Legumes and Phosphate Increase Yields

J. D. Inabnet, Eastland County (Texas) farmer, has demonstrated that winter and summer cover crops fertilized with superphosphate more than offset the depletion which successive peanut cropping exacts from the soil.

According to Floyd Lynch, recent county agricultural agent, Mr. Inabnet began using superphosphate with summer and winter legumes in 1937. During the preceding six years his peanut production averaged 8 bushels an acre, but after five years of soil treatment, the average yield for the three years, 1941 to 1943, jumped to 32 bushels an acre. A further result of the demonstration was during the 1943 drought. While some Eastland County farmers harvested as little as 2 to 10 bushels an acre, Mr. Inabnet's yield averaged 21 bushels and 15 bales of hay an acre. His production in 1944 ranged from 38 to 44 bushels an acre, Lynch says.

Mr. Inabnet planned his cropping system to include stripping his peanuts with summer legumes such as brabban running cowpeas and crotalaria, and with rye and legumes fertilized with superphosphate, after harvest. Prior to application of these methods, Lynch says that Mr. Inabnet's two cows remained in poor condition on four acres of Bermuda pasture and crop residue. Now, however, 10 head of cows remain fat on pasture alone.

Prior to his soil improvement program, Mr. Inabnet failed to get calves which, at the time, he attributed to bang's disease. Now he is getting a 100 per cent calf crop, which he believes proves that the trouble was lack of minerals in the grass and plants.—*Texas Extension Service.*



For Distinguished Service to American Agriculture

For years, the commercial fertilizer industry has been an important factor in the success of America's farmers in meeting the nation's food requirements. In wartime, that role has increased in importance.

To help the American public appreciate the true significance of that work, Bemis Bro. Bag Co. has prepared the advertisement shown here and placed it before the readers of Time and Newsweek.

You can help carry this message even further by displaying two-color poster size copies (17x22 inches) which are available without charge. All advertising material is deleted. Write for as many copies as you can use to advantage.

BEMIS BRO. BAG CO.

408-N Pine St., St. Louis, Mo.

★ *Interesting Facts About Another Industry Through Which Bemis Serves Every American Family*

"Here's an Investment that Returned 400%"

"Sam Higgins sure knew a good thing when he saw it. • Sam took over the old Taylor farm when he came home from the war last year . . . that's when he came in to see us about a loan. Well, the Taylor place hadn't been doing so well, and Sam wanted about $150 more than the bank thought was a good risk. • But Sam showed us a bag of commercial fertilizer like this and read us some government reports on crop production. It began to make sense to us, and we played along with him. Sam got his $150. • Paid it back, too . . . right on schedule. You see, Sam put that $150 into commercial fertilizer and that old Taylor place proved to be some of the best producing land in the country. The additional crops Sam raised because of that fertilizer brought him $600 extra cash AFTER he paid back the $150. That figures out to about 400%, doesn't it?"

MUCH of America's farm acreage pays similar dividends in increased crop yields, thanks to the benefits of commercial fertilizer and the extensive research done by the Department of Agriculture, State Agricultural Colleges and Experiment Stations, and the fertilizer industry.

The extra food produced because of commercial fertilizer last year totaled more than one-fifth of our entire food crops. Without that added productivity due to fertilizer, our war effort would have been tragically handicapped. Equally impressive is the fact that while the average price of all commodities purchased by the farmer has increased 80% during our war years, the price of commercial fertilizer is up only 21%.

☆ ☆ ☆

The only practical container for commercial fertilizer is a bag. Last year, the industry required more than 200 million bags to meet its needs, and Bemis is proud to have served a large proportion of the more than 900 fertilizer companies in the United States—many of them for scores of years.

Bemis makes bags of almost limitless types and sizes for literally hundreds of uses . . . and new uses are being developed daily. Remember that almost everything you eat, use or wear may make at least part of its trip to you in a Bemis Bag.

LET'S FINISH THE JOB WITH BONDS

BEMIS BRO. BAG CO.

GENERAL OFFICES: ST. LOUIS

Burlap, Cotton and Paper Bags

24 PLANTS THROUGHOUT THE COUNTRY

Phosphates on Everglade Peat Lands of Florida

Availability of the phosphorus of various types of phosphates added to everglade peat lands is presented in *Bulletin 408* of the Florida Experiment Station. Grasses, sugar cane and vegetables were used for measuring results of applying a 6–12–12 fertilizer in which the phosphorus content came from different sources: 18 per cent superphosphate, 44 per cent superphosphate, rock phosphate, basic slag, and colloidal phosphate. Plots were also established where no phosphate was used but lime was added; another in which both superphosphate and lime were used; and one containing superphosphate and sulphur.

Carpet grass was cut four to six times a year for five years from plots fertilized yearly with a 6–12–12 mixture at the rate of 1200 pounds per acre. Phosphorus for the different fertilizer treatments was supplied as superphosphate, rock phosphate, basic slag and colloidal phosphate, the last three being used 4, 2 and 1½ times the amounts of phosphorus (P_2O_5) specified in the 6–12–12 mixture. Lime and sulphur were used in two treatments with superphosphate.

The five-year average of air-dry grass was somewhat less than six tons per year for the superphosphate treatments and somewhat over six tons for the rock, basic slag and colloidal phosphate treatments. Lime with superphosphate depressed yields while sulphur was without effect.

Dallis grass gave yields in a similar order to carpet grass for the different phosphates. Lime and sulphur had no effect on the yields. In another Dallis grass test where the application was at the rate of 500 pounds per acre, the yields were highest for superphosphate.

Considering growth and phosphorus content, the summary states, response to superphosphate was best for carrots, cabbage, potatoes, rape and turnips. Sugar cane and small cuttings of shallu were seriously reduced in yield in the presence of similar treatments with superphosphate. Corn responded to a lesser extent to superphosphate than to rock phosphate and basic slag.

Prize Pasture Wins Award

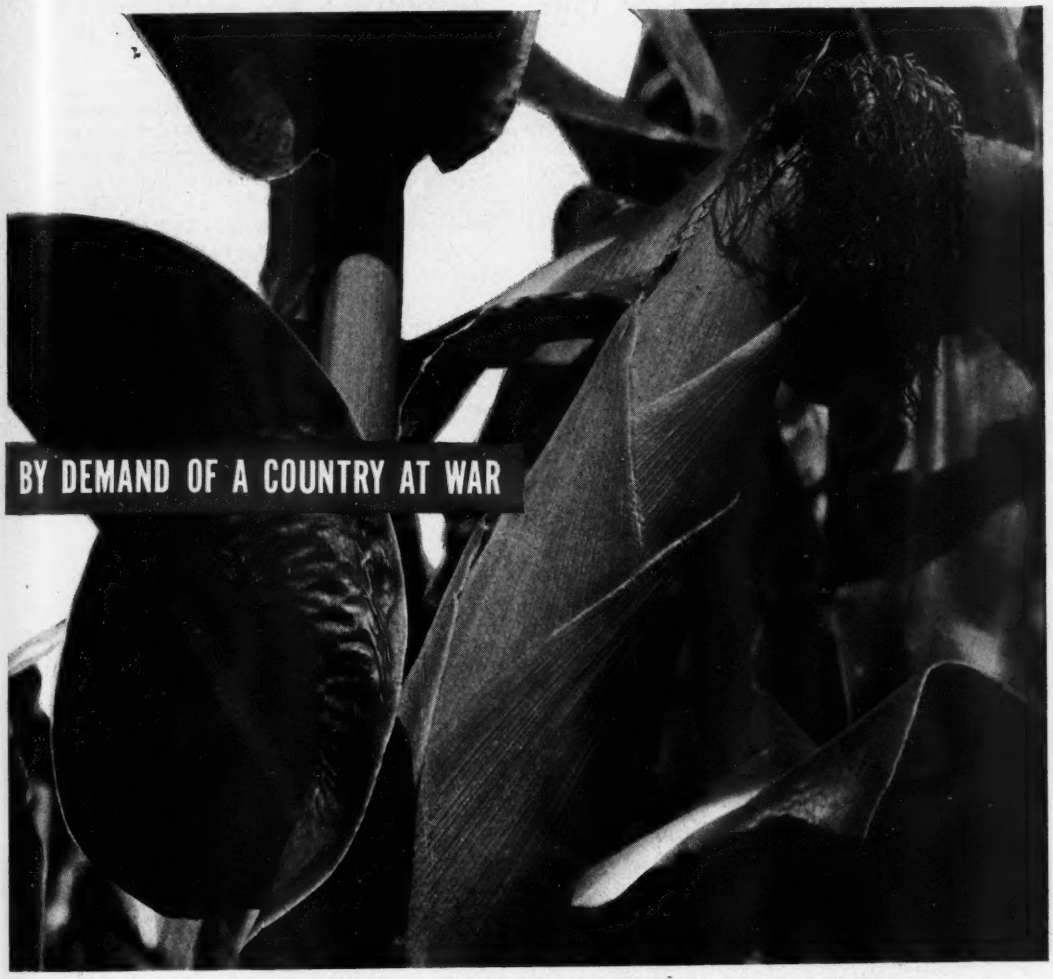
John S. Taylor, Pinellas County (Florida) farmer, recently won a certificate of merit from Pinellas County Cattlemen's Association. Mr. Taylor began improving his pasture seven years ago by applying one ton of limestone, 800 pounds of superphosphate and 150 pounds of muriate of potash per acre when he established a pasture of White Dutch, Persian and Yellow Hop clovers. Every two years he has applied a 0–14–10 fertilizer with small additions of copper, zinc, manganese, and boron. Grazing goes on twelve months in the year. Other improved pastures are growing Bermuda and Dallis grasses.

Less Cob, More Grain on Fertilized Corn

Prof. H. J. Snider, University of Illinois College of Agriculture, reporting on corn grown at Ewing, Ill., experimental field, states that on fields properly fertilized corn contained 15 per cent less cob than unfertilized corn, or 10.5 pounds of cob per 70-pound bushel of ear-corn, compared with 20 per cent cob or 14 pounds of cob per bushel of ear-corn for the unfertilized plot. "This means," he states, "that each 100 bushels of ear-corn grown on this untreated land contained 350 pounds more cob than 100 bushels of the same hybrid grown on treated land."

PULVERIZED
MASCOT
LIMESTONE
Trade Mark Registered

MAGNESIUM LIMESTONE
"It's a Dolomite"
American Limestone Company
Knoxville, Tenn.



HIGRADE
MURIATE OF POTASH
62/63% K_2O

GRANULAR
MURIATE OF POTASH
48/52% K_2O

MANURE SALTS
22/26% K_2O

SUNSHINE STATE POTASH
A PRODUCT OF NEW MEXICO U.S.A.

Reg. U. S. Pat. Off.

The demands of a country at war have made it necessary to produce more food than was ever thought possible. The credit for accomplishing this job goes to the nation's farmers, who have combined hard work with new and proved methods to increase crop yields.

An important aid in attaining these food goals is through the use of your fertilizers — most of them compounded with potash, the vital soil nutrient which provides increased soil fertility and greater resistance to disease and drought.

Sunshine State Potash is playing an important part in helping America's farmers produce the better crops and higher yields that hasten Victory.

UNITED STATES POTASH COMPANY
Incorporated
30 Rockefeller Plaza, New York City

Fertilize to Increase Low Corn Yields in the South

South Carolina

A one-bushel increase in yield of corn per acre over last year's average yield with the same acreage planted would put an additional 1½ million bushels of corn in the cribs of South Carolina, and this increase will be greatly needed next year, W. H. Craven, Clemson extension agronomist, states. To this end Craven is advising higher fertilization of this year's crop through side-dressing.

Reminding farmers that last year South Carolina's average corn yield was 16 bushels per acre on 1,510,000 acres—a big acreage but a low yield, Craven said:

"Fertilizer prices are low compared with labor costs. Growers can well afford to side-dress heavily this year. On average soils, where the crop has received 200 to 500 pounds of a complete fertilizer, side-dress with 24 to 32 pounds of nitrogen per acre. Apply the nitrogen early.

"Good judgment on the part of the farmers will determine the fertilizer need for the crop. Carefully consider the fertility of the soil, the previous crops grown, and the number of stalks per acre. The thicker the stalks, other factors being equal, the greater the amount of plant food needed per acre. Remember nitrogen is the main limiting plant nutrient in corn production. Approximately two pounds of nitrogen is required to produce one bushel of corn.

"Avoid late, deep cultivation but control weeds early. Late cultivation actually reduces corn yields."—*Clemson College (S. C.), Extension News Item.*

North Carolina

New methods for increasing corn yields in North Carolina are being tested by a large number of growers this year and the use of large amounts of nitrogen per acre, when the corn is about knee high, is one of the most important points in the plan.

State College agronomists of both the Agricultural Experiment Station and Extension Service call special attention to the five steps in increasing corn yields. These five steps are the use of a proven local variety or an adapted hybrid; adapting the fertilizer to suit the soil conditions; providing enough plants to produce desired yields; avoiding late, deep cultivation, where possible; and varying the topdresser with soil fertility and expected yield increases.

For yields up to 50 bushels per acre, 6,000 plants per acre are needed; for 50 to 75 bushels, 7,200 plants; and for 75 to 100 bushels, about 9,400 plants.

Tests have shown that where land produces from 15 to 35 bushels per acre with little or no nitrogen top-dressing, the following increases per acre may be obtained, if all practices as to plants and cultivation are followed: 20 pounds of nitrogen per acre, 10 to 12 bushels; 30 pounds of N, 15 to 18; 40 pounds of N, 15 to 25; 60 pounds of N, 25 to 35; 80 pounds of N, 30 to 45; and 100 pounds of N, 30 to 50 bushels of corn.

Fertilization recommended at planting for corn in rotation with heavily fertilized crops is 200 to 300 pounds of 6–8–6 or 5–7–5 and in rotation with legumes for seed and small grains, 300 to 500 pounds per acre. In rotation with peanuts and legumes, the recommendation is 300 to 500 pounds of 4–8–8 per acre.—*N. C. Extension Service News.*

Legume Green Manuring Slow in Action

Available ammonia and nitrates from legumes turned under in the spring, do not occur until late summer and fall, according to the Fifty-sixth Annual Report of the Arkansas Experiment Station. The reason is ascribed to organisms of decay using all ammonia and nitrate made available during spring and early summer.

Studies were made by J. E. Vaile of the Station, who states that large amounts of nitrogen were added to the soil by turning under winter cover crops, and that the nitrogen content of many soils has been maintained and in some cases increased by this practice.

Plant material collected and analyzed in April, just prior to turning under, had a higher percentage of nitrogen than that col-

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the bride wore

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*REG. U. S. PAT. OFF.

lected in May and June, but more nitrogen was added to the soil when cover crops were turned under in May than in April, because of a heavy increase in the tonnage of the crops between April and May samplings.

In the order of their contributions of nitrogen to the soil by the crops turned under, the following rank was given: (1) rye and vetch, (2) crimson clover, (3) vetch, (4) bur clover, (5) Austrian peas.

"While it is true," says the report, "that approximately one-half of the nitrogen returned to the soil is utilized in the decomposition of the cover crops, they are of considerable value as a nitrogen carrying fertilizer.

"As a result of the utilization of nitrogen in the decomposition of the cover crops, there has been no increase in the available nitrate and ammonia nitrogen content of the soil during the spring and early summer months. But there was an increase in nitrogen in the cover crop plots over the check plots, from midsummer to fall. Thus the nitrogen in the cover crops does not become available until midsummer and later, but, for long-season and fall crops, nitrogen would be present in the soil in fairly large amounts."

Soil Fertility and Plant Diseases

The interrelationship of soil fertility and plant diseases in vegetable production is discussed in the 62nd Annual Report of the New York Agricultural Experiment Station, Geneva. Tests were made with Spergon-treated and untreated pea seeds on soils receiving different fertilizer treatments. The greatest benefit from treatment always came from fertile soil and the full benefit of fertilizer was obtained only when the seeds were treated against disease.

Replicated tests showed that where no commercial fertilizer was used, 89 per cent of the plants were affected with root rot. Only 65 per cent of the plants were affected where 600 pounds or more complete fertilizer per acre were applied, and on the fertilized plots the plants had much better developed root systems and sturdier stems.

CORRELATIVE FACTORS IN RAPID CHEMICAL TESTS

(Continued from page 10)

placeable in the soil from the curve. Data in Fig. 5 are expressed in milliequivalents per 1000 grams of soil. To get the potassium oxide in pounds per acre, multiply the milliequivalents by 94. The interpretation in Fig. 6 is already expressed in pounds per acre and the calibration is for tomatoes and crops of a similar nature.

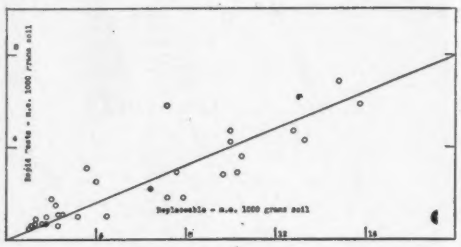

Fig. 5. Correlation of rapid chemical tests with replaceable potassium

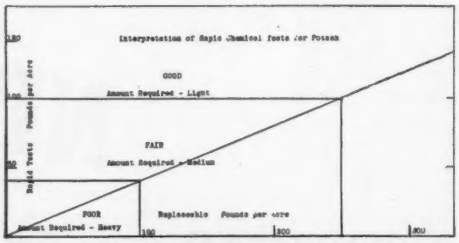

Fig. 6. Interpretation of rapid chemical tests for potash

Buffer Strength

There are a large number of factors in most soils that may limit plant growth. There is the question of soil acidity. For example, in the Coastal Plain section of the United States most soils are extremely acid in nature and for most crops this condition must be corrected. The degree to which it is corrected depends upon the soil type and crop to be grown.

The pH value of an uncropped and unfertilized soil is very significant of the conditions

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Information and references available on request.

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See Page 4

likely to be found in the soil. In other words, there has been accumulated enough information on these soils and they are similar enough for one to judge about what is to be found in the soil. However, once crops have been grown on the soil and removed, and fertilizer and lime have been added, the soil no longer remains true to form.

The soil colloids differ in composition, so the pH at which aluminum, iron and manganese come into solution varies. The tolerance of various plants for aluminum, iron and manganese varies as do the requirements for iron and manganese. Here, however, nature has been fairly kind in influencing a system whereby if proper cognizance is taken of the lime status of the soil these factors are pretty well taken care of, that is, provided adequate organic debris is returned to the soil to keep up continuously an active oxidation-reduction activity in the soil.

It must be borne in mind that various amounts of liming material must be added to the soil depending upon the amount of clay and organic matter in the soil and the degree to which the colloidal complex is saturated with calcium and magnesium. A relatively simple method of determining this factor is by a titration curve. Make up a normal sodium sulphate or sodium chloride solution and include various amounts of sodium hydroxide. To 50 gram portions of soil add 100 milliliters of this mixture and agitate thoroughly. After standing over night determine the pH value of each mixture and construct a curve. The amount of lime necessary to give a desired pH can be calculated from this curve when the sodium hydroxide equivalent is expressed in terms of the neutralizing value of lime. See Fig. 7 for an illustration of this method. A study of this information is very important for so often one over limes in regard to the amount of potash and other elements available in the soil.

To determine how much lime is required to change the soil to a given pH value, interpret on the chart the amount of lime necessary to give the pH desired. For example, it would take less than 1,000 pounds of calcium oxide to change the Collington sand to pH 7.0, but 1,750 pounds are required to change the Collington sandy loam and over 4,000 pounds for the Penn loam. This information is very important for economical farming.

Phosphorus

The keystone to agriculture has been built around the question of the availability of phosphorus. The acetate radical has been selected and the pH value of 5.0 has been adopted as having the ability to extract phosphorus from the soil somewhat comparable to the plant's ability to obtain it. If too strong a salt and acid mixture is used and iron, aluminum and manganese are brought into solution in large amounts, there is danger of precipitating phosphates and a true test not being obtained. Further, various of these compounds, that is, iron and aluminum phosphates, are not

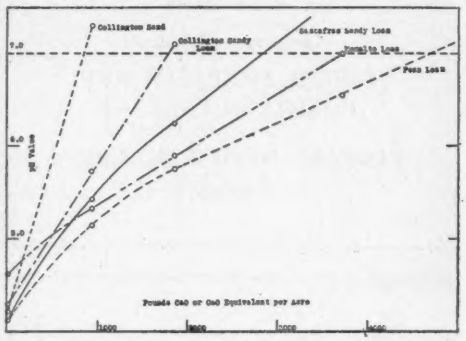

Fig. 7. Buffer curves for determining the lime requirement of the soil

available to most crops and should not be brought into solution any more than they already exist actively in the soil. Fig. 8 shows that a complete system of testing is necessary for many soils.

The sodium acetate mixture used by the author is 0.3 normal in respect to acetate ion, sodium and hydrogen. Both sodium and hydrogen replace the calcium, magnesium and potassium and ammonia (manganese, aluminum and iron) from the soil complex and the acetate ion replaces the phosphorus and other anions from the soil. The hydrogen and sodium are in great excess of those cations held by the soil even in highly buffered soils.

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Fig. 8. The influence of lime, fertilizer and trace elements upon the growth of tomatoes in virgin New Jersey soils. From left to right: no treatment; NPK only; lime only; lime, NPK; lime, NPK, trace elements

This causes an early equilibrium to be established thus permitting rapid analyses. Likewise the acetate radical is in great excess of the anions present in the soils and has a replaceable action upon them.

The reader is invited to study closely the procedure set forth in the published literature describing the simplicity of the soil and plant tests, the relative accuracy of the tests and the accomplished success with the methods. These tests are not just spot tests or quick qualitative indications, but reliable chemical methods established by painstaking research.

Organic Matter

A clear picture is not established about a soil until the amount of organic matter the soil contains is known. This organic matter content must be correlated with the soil type. The organic matter gives a clue to the amount of nitrogen in the soil and to what extent nitrogen may be made available from this source. Factors have been published regarding the possible reactions and amount of nitrogen available from this source.

So, if one is interested in learning about the chemistry of the soil, let him use a system of analyses and study the changes through the season as correlated with weather, crop grown, soil type and fertilizer practices. Available literature on the particular system used in this laboratory on soils and plants can be had by application to the author.

Summary

Correct interpretation of rapid chemical analyses of the soil is no solution to all the chemical problems of the soil. It is, however, when carefully carried out by competent personnel and correlated with existing standard chemical analyses and crop performances, of significant importance and gives a world of information about a soil. When this information is translated into the requirements of the soil for a particular crop to be grown and the proper amendments added, the result is a better system of crop production. An appeal is made to those using rapid chemical tests on soils and plants to use a standard procedure and a system that can be reproduced, that will give fundamental knowledge, and has been correlated with field and greenhouse studies.

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